

Notes on the Nidification of the Pied Harrier, *Circus melanoleucos* (Pennant), in Amurland, U.S.S.R.

BY

I. A. NEUFELDT

*Zoological Institute of the Academy of Sciences of
the U.S.S.R., Leningrad*

(With four plates)

The Pied Harrier, *Circus melanoleucos* (Pennant), is a rather common visitor to India. As a breeder, it is now practically confined to the north-east of the country, to Assam, an area isolated from the main nesting range.

In many of its habits the Pied Harrier resembles other Harriers wintering in India, and often associates with them. Adult males can be easily recognised by the distinctive black and white plumage, differing from other species of the genus (Plate I, *above*). The breeding biology is still insufficiently known, although the bird is rather common in the northern parts of its range.

This paper is based mainly on data gathered by the authoress during her expeditions to Amurland (SE. Siberia, U.S.S.R.) in 1957-1959 and 1961-1962.

GEOGRAPHICAL DISTRIBUTION

In the Soviet Union the Pied Harrier is a common summer resident of the plains and wide river valleys in the Primorye Territory (Ussuriland), Amurland, and Transbaikalia. The breeding range in the U.S.S.R. is as follows: according to L. Shulpin (1936) and K. Vorobiev (1954) it is common in the southern parts of the Sikhote-Alin Range (the valley of Suchan River), but has never been seen on the eastern slopes of the range. The easternmost point of its range in the valley of Amur River is village Padali near the city of Komsomolsk (Kistyakowsky, Loskot & Smogorzhevsky 1962). North

of the Amur it was found at Bureya River near village Ostrovnoe (Kistyakowsky & Smogorzhevsky 1963) and at Zeya River near Zeya town (Collection of the Zoological Institute). The western part of the north boundary of the breeding range is still unclear. At any rate the Pied Harrier is known from the town of Skovorodino (the authoress's observations), the lower course of Argun River, the towns of Sretensk and Darasun (Radde 1863; Taczanowski 1872; Gagina 1961). The Pied Harrier occurred casually in some places along the eastern coast of Lake Baikal (Verkhnya Angara River, Barguzin River, the delta of Selenga River, and the valleys of Irkut and Djida rivers) but breeding there was not proved (Gagina 1954, 1960 a, b; Izmailov 1958).

Outside the limits of the Soviet Union it inhabits most parts of NE. China (Manchuria) and the northern parts of Inner Mongolia (Ingram 1909; Kuroda 1918, 1931; Meise 1934; Yamashina 1939; Caldwell 1931; Piechocki 1958). From NE. China it probably penetrates to N. Korea (Austin 1948). According to T. H. Shaw (1936), the Pied Harrier visits Hopei province during autumn and spring migrations only, though two males he mentioned in his book were collected near Peking on 8th May, i.e. they could be breeding birds. The Pied Harrier was met in the north-eastern parts of the Mongolian Republic—along the lower course of Kerulen River and on the shores of Lake Buir-Nor (Tugarinov 1932). The southernmost breeding places of the Pied Harrier known are widely separated from the main range, being located in N. Burma (Myitkyina) and the adjoining plains of Assam (Cripps 1882; Hume 1888; Baker 1935; Stanford 1935; Smythies 1953). H. Harington (1903) has observed these birds in the south of Shan State (Burma) on 10 and 28 July. He supposed them to be breeding birds.

Evidently the Pied Harrier has two widely divided breeding areas. Very probably, this disjunction arose within historical times. The vast plains of central and south China have been cultivated for thousands of years, and in the process the breeding habitats of the Pied Harriers were probably destroyed and turned into fields.

Throughout its range the Pied Harrier is a migratory bird. A part of the southern population may be resident but more probably they undertake short distance regular seasonal movements. According to W. Legge (1880) the female collected in March in Ceylon had her gonads enlarged as if breeding was to commence very soon. This suggests that the breeding area of birds wintering in Ceylon is not far from that island, perhaps in Assam or Burma. According to I. Kalinowski's observations (Taczanowski 1893), the Pied Harrier

sometimes winters in small numbers in S. Ussuriland. G. Wilder and H. Hubbard (La Touche 1932) saw them till December or even January in N. China during several years. In winter this harrier can be seen over rice-fields, bogs, and wet meadows in all parts of India, and it is only in the north-western and central States that it was rather seldom seen. The Pied Harrier is known as a winter visitor to East Pakistan and as a rare vagrant in West Pakistan; it happens that it stays in Nepal; it is very common and widely distributed at non-breeding time in the plains of S. Burma, in the grass marshes and rice fields of Thailand and in similar habitats throughout Indo-China and Malacca; in S. China it was recorded in winter in Yunnan, Kwangsi, Kwangtung, Fohkien, etc.; it is seen irregularly in swampy plains with small bushes and trees on the NW. coast of Ceylon; the southernmost points are Borneo and Philippines (Jerdon 1862; Bingham 1880; Legge 1880; Davison 1883; Oates 1883; Hume 1888; Donald 1905; Baker 1928; Caldwell 1931; Hachisuka 1934; Stanford 1935; Whistler & Kinnear 1936; Deignan 1945; Delacour & Mayr 1946; Delacour 1947; Ali 1953; Smythies 1953; Worth 1953; Eaton 1957; Ripley 1961). In Burma and Thailand, according to some authors, the Pied Harrier is the commonest wintering species of the genus *Circus*.

HABITAT

Within the limits of the breeding range mentioned above, the Pied Harrier is confined to flat treeless and usually boggy country. In Ussuriland for instance they haunt meadow land, river valleys, and mossy bogs with thinly growing bushes; in search of food they visit agricultural land and well drained hill slopes covered with grass, thickets of filbert, and dwarf Mongolian oak (Dulkeit 1928; Shulpin 1936; Spangenberg 1940; Vorobiev 1954). In similar habitats these harriers breed in the northern provinces of China. In Assam and N. Burma at the breeding period they also frequent high grass meadows covering wide boggy flood-plains or depressions among hills (Hume 1888; Harington 1903; Baker 1935; Stanford 1935). In the steppes of Transbaikalia and E. Mongolia they keep to places with luxuriant grassy vegetation mainly along river valleys and lake shores, but they were also met far from water (Radde 1863; Taczanowski 1893; Stegmann 1929; Tugarinov 1932; Nasimovich 1949).

In the South of Amurland the Pied Harrier is a very characteristic inseparable component of biocenosis of flood-plains and hummocky bogs (Stegmann 1930; authoress's observations). In the Svobodnyi District its favoured breeding places are willow and dwarf birch

thickets growing in very humid areas. Such boggy thickets grow on the bottom of shallow hollows which serve as a drainage for thawed snow and rainwater (Plate I, *below*). In wide valleys this plant association usually alternates with grasslands and birch groves. The brush cover is formed by dwarf birch (*Betula fruticosa*) and willows (*Salix brachypoda* and *S. myrtilloides*). These plants sometimes spread out on waste territories and form entire impassable thickets, 1-1.5 metres high. The herbage consist mainly of sedges (*Carex schmidtii* and *C. minuta*) forming hummocks up to 30 cm. high. In the monsoon, rainwater between the hummocks favours the growth of mosses (*Sphagnum* and *Aulacomnium palustrae*). Here on the hummocks settles moisture-loving herbage (*Sanguisorba parviflora*, *Saussurea amurensis*, *Trollius ledebouri*, *Angelica maximowiczii*, *Ligularia sibirica*, *Iris setosa*, *I. laevigata*, *Hemerocallis minor*, *Caltha palustris*, etc.). Among these plants the globe flowers, irises, and yellow day lilies are especially numerous; with their bright flowers they decorate in summer the monotonous green background of sedges and shrubs. Here and there develop patches of the rough blue joint reed-grass (*Calamagrostis langsdorffii*) and above the trimmed looking thickets rise stunted solitary Asian white birches (*Betula platyphylla*) and Dahurian larches (*Larix dahurica*). At the edge of the forest the variety of the trees increases and includes dwarf Dahurian birches (*Betula dahurica*) and aspens (*Populus tremula*). People and domestic animals visit these thickets rather seldom since they are useless both for haymaking and grazing—a thick layer of dried grass of the previous year prevent growth of fresh grass till the middle of June; moreover, countless hummocks and bushes hinder mowing. Therefore the Pied Harriers find good shelter for their nests well protected from disturbance even when the thickets are close to villages.

Some pairs of Pied Harriers I was able to observe nested on hummocky meadows in the flood-plains of creeks and streams. Numerous mushroom-shaped hummocks (about 50 cm. high) formed by sedges and reed-grasses were surrounded by stagnant water. Herbage was represented mainly by different irises (*I. orientalis*, *I. setosa*, *I. laevigata*) and globe flowers (*Trollius ledebouri*). Solitary dwarf birches and willow shrubs or small groups of them were scattered on the flood-plain; some Spiraea shrubs were growing in water filled depressions. After heavy rains the rapid streams inundated these meadows for a short time and carried away all the birds' nests (including the harrier nests) built on the ground or just above the ground level.

The nest sites mentioned above were at the same time the principal hunting territories of this harrier. In search of prey the birds visited also dry meadows, cultivated fields, layer field edges, drainage pipes overgrown with vegetation, and open shores of water bodies. Along the valleys they penetrated even into dense forests.

In several years of observation in the Shimanovsk and Svobodnyi districts of Amurland I saw the Pied Harrier willingly occupy nest sites in very narrow (100-150 metres in length) as well as in wide creek valleys stretching for many kilometres. The presence of open plains near the nesting territory was necessary. They avoided the birch willow thickets growing in birch woods or mixed oak and larch forests covering the plateau and its gentle slopes.

The individual range occupied by a single pair of Pied Harrier is usually limited: beside the nesting territory (no more than 2.5 hectares) defended by birds, it includes a hunting territory. The size and outlines of the latter were very variable. Where the nests were built in vast meadows or thickets rich with food the birds hunted near their nests and no farther than 1.5 km. If food was inadequate in territories adjoining the nest site or the nesting territories were separated from the hunting territories by a forest belt, the birds either undertook long distance (up to five km.) flights, or enlarged their search routes by quartering all neighbouring small branches of valleys, clearings, and edges of forests. Pied Harriers are very much attached to their haunts and return every year to the same place notwithstanding deterioration of the habitat. In this connection the observations made upon one pair which nested in 1961 in a marshy thicket near Klimautzy village are of interest. In the following spring a forest fire destroyed in this territory (about 70 or 80 hectares) all the bushes and dried grass. Nevertheless, the Pied Harriers nested at the very edge of the forest on a small dwarf birch thicket (28×10 metres) which escaped the fire. Since the fire had devastated their former hunting territory, they were forced to hunt in places they had not visited before.

In 1958-1962 the number of the Pied Harriers in the Svobodnyi district was rather high and one wide creek valley (2.5 km. in radius) held three pairs. The nesting territories of two of them were close to each other, and nearly in all cases their hunting ranges overlapped; nevertheless the relations between birds belonging to different pairs were very peaceful, and I have never seen them fighting over their territories. According to E. Spangenberg (1940), at the lower course of the Iman River (Ussuriland), the distance between separate nests of this bird was no less than one kilometre.

In Amurland in the vicinity of the Pied Harrier nests, and very often in the same habitat, bred the Yellow-breasted Bunting (*Emberiza aureola*), the Lanceolated Warbler (*Locustella lanceolata*), the Siberian Ruddy Crake (*Porzana paykullii*), and the Stonechat (*Saxicola torquata*), and sometimes the Pallas's Grasshopper Warbler (*Locustella certhiola*), the Spotted Bush Warbler (*Tribura taczanowskia*), and Quail (*Coturnix japonica*).

THE SPRING ARRIVAL

Usually the Pied Harrier leaves its winter quarters later than other species of harriers. Single birds have been noted in S. India (Travancore) till the beginning of April (Ferguson & Bourdillon 1904); in Manipur they stay till the middle of April, and some birds, which probably bred somewhere near by, were recorded even at the end of May (Hume 1888). The Pied Harriers left their winter quarters in northern Thailand not earlier than the middle of April (Deignan 1945). In China and S. Yunnan, they remain till April (La Touche 1924); at the same time they were migrating in Kiangsi province (Caldwell 1931); up to 11th April they were recorded in the western part of Kwangsi (Eaton 1957). Northwards, in Hopei, the migration of these birds takes place in April and May (Shaw 1936; Wilder & Hubbard 1938).

At the breeding grounds in the vicinity of Harbin (Manchuria) Pied Harriers were shot at the beginning of May (Meise 1934), and in Korea (Kyonggi Do) the earliest birds were collected at the end of April (Austin 1948). According to G. Duikeit's (1928) observations over several years in the southern parts of Ussuriland (U.S.S.R.) the first solitary males arrive at the end of March or the beginning of April. A marked increase of their numbers was recorded by the same author in April. Some other ornithologists list later dates of spring arrival for that territory, namely 10-29 April and even 4-11 May (Bolau 1881; Dörries 1888; Shulpin 1936; Spangenberg 1940; Omelko 1956).

Unfortunately I got no chance to observe the exact time of the spring arrival in Amurland of the Pied Harriers from their winter quarters. There are in the collection of the Zoological Institute two males which were collected early in spring in this region; one by B. Stegmann on 5th May on Zeya River (60 km. up the river from Blagoveshchensk), and the second one by V. Dorogostaiski on 9th May on the same river near Pikan. No doubt the Pied Harriers arrive a little earlier, since in 1958 when going by train to the study area I saw on 21 and 22 April, males in search of prey flying above vast hummocky bogs between Ushumun and Shimanovsk, as well as

in suitable habitats near the towns of Svobodny and Belogorsk. At that time the bogs were still covered with snow here and there. The next day Pied Harriers were rather common in the wide marshes, with numerous isolated lakes, in the flood plain of the lower Zeya River. In 1959 the beginning of May, I regularly met males and females in the southern portion of the Amur-Zeya interfluve. The birds, back from their winter places, leisurely fly (sometimes in the company of Hen Harriers) low over the ground, hunting for prey in the dead grass and bushes. At that time the weather in Amurland is usually cold and windy. Snowfalls and snowstorms happen rather often, and the night temperature is no more than -4° C. Only after 13 or 14 May does the spring influence become more and more evident. Sun thaws the remaining snow, and the soil gradually thaws out eagerly absorbing the water filling depressions among the hills. Though night frosts as a rule takes place till the end of May, on the southern, well-insulated slopes and on the plateau the first plants (sedges, willows, pasqueflower, and rhododendron) begin to blossom. The insects wake up, the numbers of amphibians increase, and rodents become more active, and the Pied Harrier's hunt becomes easier and more productive.

DISPLAYS, COURTSHIP

Just after returning from winter quarters the Pied Harriers occupy their territories and stay there during all the breeding period until young birds are able to fly. Only natural calamities such as forest fires and monsoon floods destroying nests and worsening foraging conditions force the harriers to change the boundaries of their range. Similarly, late ploughing and haymaking restrict the hunting territories of Pied Harriers. Pair formation probably takes place in April, but till 10 or 12 May, males and females more often hunt separately, and sometimes at a long distance from each other.

After May 15 the Pied Harriers begin their displays. It is a very peculiar display flight, performed usually by the male but sometimes by the female or by both birds together. At the height of the display period (17-22 May), if the weather is fine and windless, the birds begin their display at sunrise and continue their remarkable evolutions in the air by day. At the beginning the male soars rather high over the nest territory, then suddenly plunges down with closed or partly closed wings and, after a headlong dive, rises nearly vertically with a loud call *ke-ke-kee*, a toneless cackle. As he rises the male somersaults several times. The steep ascent is followed by

a new and sudden spectacular dive, and then an easy rise with breath-taking aerobatics, accompanied always by the characteristic display note. After each dive the harrier gradually loses height. Approaching the ground he rolls one or more times on his long axis, not only at ascents but at descents also. The black and white bird displaying early in the morning is a delectable sight against a background of bright blue cloudless sky. At the beginning of the breeding season several males belonging to pairs living side by side display simultaneously before one female as if competing in adroitness. The female during her evolutions in the air also rolls and somersaults. Being pursued by the cock she usually stops her aerobatics, turns momentarily on the back to ward off the male. The call uttered by the female in this flight is a similar nasal cheep. When the male is displaying alone he, from time to time sinks into the tall growth of the previous year's grass, near his sitting mate or in the vicinity. Sometimes he takes to wing with a small twig in his beak; and transferring it to his claws starts to glide over his mate resting on the ground. The twig being dropped the male sinks to the grass and calls the female, who answers his low *cluck* with a shrill whistle. After a short interval the male again gains height and repeats his display manoeuvres, and so on.

Such displays continue during nest-building and even when the first egg is laid, though the male alone is busy with his aerobatics. The last displaying males were recorded by me on the Amur-Zeya plateau on 25 May 1961 and 28 May 1962.

On May 20, in the vicinity of Klimautzy village I happened to observe the first copulating Pied Harriers. Soon after a display flight, the male landed at the nest site (70-80 metres from the clearing where the harriers two days later began to build their nest) and his mate approached him. She drove away the male and occupying his place on the top of the hummock delivered a drawling whistle, ruffled her plumage, and shook her wings; at the same time she attentively watched her partner circling over her. After some circles were made the male suddenly stopped his flight and raising his wings high up alighted on the hen's back. Immediately after completing copulation he flew away, leaving her alone for some time on the ground. Subsequent coitions took place at the nest.

About a week before the nesting period the females nearly stop hunting. From the end of May onward they live solely on the food provided by males and Pied Harrier hens flying in search of food over the dwarf birch and willow thickets are very seldom to be seen. More often the female sat with ruffled feathers on a hummock, a

low stub, or a low branch of the squat larch or of a dead fallen tree somewhere in the creek valley in the vicinity of her future nest. The moment the female saw the male she swiftly flew out to meet him, and begged for food. If the male was returning without prey, or if he ate it surreptitiously the female passed from begging for food to an active attack. She struck him on the wings with her beak and feet, and pursued him with a shrill whistle till he left the territory. If the female did not notice the male immediately on his return, he descended into the thickets and uttered a very peculiar bi-syllabled quacking chatter. As a rule this gave no results, and he then flew up with the prey in his talons where she could see him. If the female was flying below the male she took the food from him from below with striking dexterity and swiftness. In several cases the prey was passed in mid air from foot to foot or from the male to his mate on the ground.

Both mates spent the night on hummocks among grass and shrubs, separately, and at several metres from each other. The roosting place of the male was more or less constant throughout the summer season. From the beginning of egg laying the female passed her nights in the nest. On frosty May nights it was always particularly cold in damp hollows; and after sun rise the area remained for a long time in the shadow of hills and surrounding forest. This is probably why the Pied Harriers rose from the ground early in the morning and perched on the tops of sun-lit trees at the very edge of the valley. At first the birds basked motionless in the sun, then began preening. Soon the male flew away to hunt while the female continued basking till it becomes warmer and grass and thickets become dry on the surface.

It is of interest that, contrary to other harriers, the Pied Harriers readily perched on trees—males occupied in general high bare-topped pines and larches, females preferred small trees.

BREEDING

The nest and nest building:

The male played a dominant role in selecting a place for the nest and in the collection of materials. Some days before nest building began he could be seen flying with twigs or blades of grass in his claws, and haphazardly leaving the material on the hummocks. Meanwhile the female flew near by showing little interest. In Amurland the majority of the Pied Harriers started nest building 21st-23rd May, and some solitary pairs 7-10 days later.

In all cases known to me nests were built on hummocks covered with dry sedge and were well disguised among thick grass and shrubs

Neufeldt : Pied Harrier



Above : Pied Harrier male in flight ; *Below* : Habitat of Pied Harrier in Amurland, May 1958.

(Photos : I. Neufeldt)

Neufeldt : Pied Harrier



Above : Nest and eggs of Pied Harrier ; *Below* : Pied Harrier chicks in first down.

(Photos : I. Neufeldt)

(Plate II, *above*). Flooded meadows, where during heavy summer rains the nests were easily destroyed by water, were usually avoided; the birds settled there rather unwillingly and chose the highest hummocks. On the contrary in the valleys even small hummocks were not flooded by rain-water and served for this reason as a rather reliable ground for the primitive constructions of these birds.

Building materials were usually collected near by. The male was repeatedly observed by us walking about in the previous year's grass or near old haystacks and picking up straws and thin twigs. When flying up a male usually shifts its burden from the beak to the feet and only then brings it to the nest. The hen was usually waiting below among shrubs of dwarf birches. She arranged the material and did practically all the building work, but did not carry building material. Each appearance of the male was met by her with a loud shrill whistle (similar to the 'food-call'). The male either dropped twigs and blades of grass in the nest or raising his wings above the back settled in the thickets and himself arranged the material. Small larch or birch twigs were used for the bottom and outer borders of the nest; straw of wild cereals e.g., *Calamagrostis langsdorffii*—for the walls; fine leaves of sedge and soft parts of other plants for lining the cup. Usually nest building took from 3 to 4 days.

When ready the nest is a thin (not more than 30 mm.) and at first rather loose in construction. The measurements of eight newly-built nests in Amurland were as follows: external diameter 230-270 mm., internal diameter 140-160 mm. and depth of the nest cup 45-60 mm.

Later, during incubation and when there are nestlings in the nest the walls gradually thicken reaching sometimes 120-130 and even 150 mm. The fact is that during the whole breeding period the hen (very seldom the cock) renews the construction. No case is known when the frightened female returned back to the nest without bringing a bunch of dry grass or twigs.¹ This behaviour can hardly be attributed to her wanting to keep the nest clean because she begins to add material in the nest long before hatching. I think that the building up of the nest aims at protecting the eggs and then the nestlings against the moisture soaking into the nest from below from the ground during rainy season. Apparently such superstructured, more solid nests were erroneously taken by G. Dulkeit (1928) for old ones, used in previous years. Later his opinion found its way into a number of ornithological reviews (Dementiev 1951; Portenko 1951). In fact, every year the Pied Harriers return to their former breed-

¹ The exceptions are flights with food for chicks,

ing place and build a new nest in the vicinity or at a rather long distance from the old one.

When the nest is built the hen often sits in it though egg-laying starts only 4-5 days later. Now she rarely leaves her nesting area keeping close to the region of the nest, and gives her alarm-call while chasing crows, kites, and other large birds which encroach upon her territory, and shows alarm at the appearance of man.

Breeding season:

In the different parts of their rather limited and separated breeding range, Pied Harriers start breeding at different times. In north-eastern India and in the north of Burma nests containing one egg were found on 13-20 April (Hume 1888; Stanford 1935). A month later the first eggs were laid in Manchuria and Ussuriland (Dulkeit 1928; Yamashina 1939; Spangenberg 1940). Near the northern border of their range (Amur-Zeya Plateau) the laying began only at the end of May. Thus, in the nests found in 1961 and 1962 in the vicinity of Klimautzy village the first fresh eggs were recorded on

TABLE
EGG MEASUREMENTS

Serial No. of nest	Egg number	Absolute size (in mm.)		Average size of eggs from one clutch (in mm.)
		Length	Breadth	
1	I	42.5	35.0	42.4 × 35.0
	II	42.0	35.0	
	III	42.0	35.0	
	IV	43.0	35.0	
2	I	44.0	36.0	44.9 × 35.9
	II	44.5	35.0	
	III	45.0	35.0	
	IV	45.0	36.5	
	V	46.0	37.0	
3	I	45.0	34.5	45.5 × 35.7
	II	45.0	36.5	
	III	46.0	35.0	
	IV	46.1	36.8	
4	I	47.6	35.0	48.8 × 35.7
	II	49.0	36.3	
	III	49.3	35.3	
	IV	49.4	36.0	
5	I	43.0	35.0	43.7 × 34.8
	II	43.0	35.0	
	III	43.4	34.0	
	IV	45.7	35.0	
6	I	42.5	38.0	44.3 × 37.2
	II	43.0	37.0	
	III	44.0	37.0	
	IV	46.0	36.0	
	V	46.0	38.0	

26, 28, 29 May and on 1, 2, 8 June. In the first half of June over the investigated territory nests had full clutches and only a few individuals were laying as late as the middle of the month.

Clutch size, eggs:

Eggs were usually laid in the morning, as a rule at intervals of 48 hours. Once a hen laid the last (her third) egg, three days after the second. The normal full clutch of the Pied Harrier consists of 4 to 5 eggs. 50% of nests found in Amurland contained 4 eggs, the others 5 eggs (Plate II, *above*). All clutches found in southern Ussuriland, described by G. Dulkeit and E. Spangenberg, consisted of 5 eggs. For Transbaikalia nests are known with 4 and even 3 eggs (Taczanowski 1893); the latter are supposed to be incomplete.

The eggs are roundish. Only in one of the nests (No. 4 in the Table) the eggs happened to be somewhat elongated, and their length exceeding their width by 13 mm. In other instances this difference was less (7.0-9.0 mm.). The table presents the main measurements of eggs from 6 nests examined near Klimautzy village. As one may see from this table the size of eggs varies insignificantly not only within one clutch but also between nests belonging to different individuals.

No difference was seen on comparison of these measurements with those from Transbaikalia, Ussuriland and Manchuria.

The egg is usually pure white, occasionally bluish-white, without gloss. As the female's feet were constantly stained with blood from its prey, after several days of incubation the eggs had definite red-brown streaks and spots; these are erroneously taken by some ornithologists for natural pigmentation of the egg-shell.

Incubation:

During the breeding period the duties of the parents were sharply differentiated. I never saw the male brooding the eggs. L. Shulpin (1936) writes that he never found brood patches in Pied Harrier cocks. These were not found in specimens from the collection of Zoological Institute of the Academy of Sciences as well as in males shot in Amurland in 1957 and 1959. Eggs are incubated by the hen only, and this is not an exception among the harriers. However males have been twice reported as flushed from nests containing eggs, with females alive (Dulkeit 1928; Spangenberg 1940). Though in both cases the reason of male's stay in the nest was not clarified, these observations led to other authors writing of the participation of the

male in incubation. It seems more probable that the male was flushed from the nest, when he delayed there after feeding his mate or after laying in the nest additional building material.

The incubation begins with the first egg. During the first two days a female does not stay in the nest all the time. In the morning she flies out to warm herself for a while in the sun, and during the day when she feels very hungry. With each addition to the clutch she sits more closely. The full clutch is usually left by the hen, only for accepting food. Within the period of egg-incubation the behaviour of females differed a great deal. Some took wing on the appearance of a man at 5-6 m. distance from the nest, but the majority allowed a very close approach and flew out calling almost from one's leg. Such difference in their behaviour depends apparently not only on the individual peculiarities of temperament but also on the radius of the field of vision, which is different in birds sitting in the dwarfish sparse thickets or in the thick impassable shrubs of dwarf birches and high grass. In contrast to dendrophyllous birds of prey, which from their nests high above the ground easily notice a stranger intruding into their territory, harriers living in grass and shrubs may see an enemy only at a short distance from the nest¹. The Pied Harrier hen sitting on eggs (or chicks) is always alert to noises in the vicinity. At the slightest rustle she raises the feathers of the facial disc and turns the head in the direction of the source of sound (Plate III, *below*). Under the peculiar ecological condition of nesting the wonderfully developed acoustic sensitivity of this bird fixes the direction of approaching danger earlier than the eye does. However, only on seeing the enemy does the female fly up.

Within the whole breeding period the male's duty consists mainly of feeding his mate and then the chicks. Having returned after the hunt with prey in the talons the male usually calls his mate out of the nest and passes food to her in flight. Sometimes the transmission of food takes place in the nest; nevertheless the hen always eats the prey somewhere away from but in the immediate vicinity of the nest. If the male is not occupied in hunting he perches in a tree or on a stump not far from the nest. He notices an approaching man right away, raises an alarm, and flies out to meet the enemy. In this moment the female gets alert and flies from the nest to join the male and they begin circling above the intruder uttering characteristic alarm notes. At the end of incubation when chicks have hatched both parents defend their nest more actively and may become brave enough to dive at a great speed trying to strike the intruder's head.

¹ This refers to birds in the nest only.

E. Spangenberg (1940) reports that in case the female dies the male is capable of taking her place on the eggs.

It is known that the period of incubation depends on the duration of the embryonal development of the nestlings. For Pied Harriers (on the Amur-Zeya Plateau) the duration of incubation was observed to vary under natural conditions. Even in the same nest it varies from 30 to 32 days for each egg. In the first egg the embryo takes one or sometimes two days longer than in other eggs, apparently due to irregular brooding by hen during the first days of incubation. The period from the laying of the first egg till the hatching of the last nestling lasts (depending on the size of the clutch) 37-39 days.

In the majority of nests examined the hatching of chicks took place in the first ten days of July and only in delayed clutches lasted up to the end of the month. The hatching process of the nestling takes on an average about a day. In one instance it took more than two days. The number of unfertilized eggs is small. Out of 31 eggs only one (in the clutch with 5 eggs) was added.

The nestlings' growth:

Newly hatched chick is covered with short but rather thick (except on the belly) down (Plate II, *below*) which on the greater part of the body is of a pale colour; on the forehead, nape, chin, external edge of the wing, tibia, and abdomen it is white. There is a stripe formed by very short darker down, passing from the bill through the lores to the eye, and a brownish-black down ring around the eye. The eyes of the newly-hatched chick are half-open; upper mandible, the top of the lower mandible and the skin of the edges of eyelids black; the cere, mouth wrinkles, and the base of the lower mandible yellowish-pink; the skin of the body pink; legs and claws of wax colour. The male nestlings at this age weighed 18-18.7 gm. the females 22.6-22.8 gm. Since the hen incubates from the first egg the young hatch out at different times. At the hatching of the last chick the first one is already 3-5 days old. For individuals belonging to one and the same sex this means a difference of 23-25 gm. On the fourth day the young Pied Harriers can move about the nest, leaning upon the tarsus and balancing with their wings. They are capable also of crawling away, into dense grass and thickets. On the first day of hatching the excrement of the chicks remains in the nest or is eaten by the hen, later the nestlings before each defecation move backwards to the edge of the nest and defecate a great distance away from its edge. The 6-day old chick develops the feather-tubes of the future remiges and their coverts

which, as well as rectrices, force out the first down; the sheaths of the second down begin to unfold.

The second down plumage develops on the pterylae and apteria of the previous juvenile plumage. In the first instance a part of second down grows in addition to the previous (first down) plumage. In the second instance the whole down plumage is of primary origin. When the nestling is about two weeks old the growth of the secondary down plumage is completed. New down evenly covers the body of the nestling. Only some parts along the neck, on the lower throat, under wings, and on the abdomen remain bare. The second down differs from the first in having more of barbs and barbules. The colour is darker, ochre or pale-ochre. Only on the nape, on both sides of the head, and on the forehead the down is white. On the 14th-15th day young males weigh 140-142 gm., i.e. reach nearly half the weight of adult individuals of the same sex. The weight of adult birds shot in Amurland: ♂♂—283.4 and 302 gm., ♀—600 gm. The movements of two-week old nestlings are rather uncertain but they already lean upon the toes. The hen broods its growing young since they need warmth, especially at night and in rainy weather. When it is hot chicks often leave the nest, which is not protected from the sun's rays, and hide themselves in the shade of grass and thickets. On hearing the female's feeding call they return to the nest. On the approach of the observer the chicks move backwards in fright and then strike a defensive attitude, characteristic of all young diurnal predators: lying on their back, feet with sharp claws up.

17-18-day-old nestlings stand firmly on their feet and in case of danger try to hide themselves in dense thickets. Little by little they tread out visible paths between hummocks on which they may quickly and without difficulty move for some metres from the nest. Sometimes 19-20-day-old birds leave their nests and settle in another place. The female (and sometimes the male) thereupon brings twigs and straws and soon in the crushed sedge there appears a new nest similar to the old. The young remain in or near this nest for about one month. In the second half of August, the 35-45-days-young take to the wing, but are not fully fledged.

Though a normal clutch of Pied Harrier consists of 4-5 eggs, the brood usually has no more than 3 young. The mortality of chicks especially in the early stages of post-embryonal development is very high. Out of 30 chicks from nests known to me only 20 (67%) lived as long as two weeks. First of all dies the youngest (the fourth or fifth) nestling in the brood. It hatches 3-5 days later than the others, and is very weak. Being jostled away by its older brothers during

feeding it seldom receives its share of food. With age its weight does not increase, on the contrary, it decreases. On the 3rd-4th day such chicks cease asking for food and lie nearly motionless in the nest and soon die. Grown up 7-12-days-old chicks, which are in the habit of leaving the nest, sometimes become so wet in rainy season that they perish from cold due to the imperfection of their heat regulating abilities. Sometimes, dispersed in different directions, young birds become an easy prey of predatory mammals. In July of 1962 one brood was entirely destroyed by forest fire which spread to the territory occupied by the Pied Harriers.

When in the nest the young birds can be infested by different arthropods: ticks, mosquitoes, black flies, etc. The main injury is done by parasitic larvae of flies of the genus *Protocalliphora*, which penetrate external ear openings and acoustic ducts, nasal ducts, quills of growing feathers or simply settle on parts of the body stained with blood by the hen's feet. A very strong infestation by these larvae blocks nostrils of chicks; breaking through the ear-drum they penetrate the middle ear and sometimes injure large feathers to such an extent that some of them break off.

Behaviour of the parents:

With young in the nest the duties of the parents are again strictly differentiated. The male provides food for the family, the female broods and feeds the chicks. But as was observed in 1961 when the hen was shot after hatching all the nestlings, its mate successfully fulfilled all her duties.

Pied Harriers are born coldblooded (poikilothermal). Within the first two weeks until thermoregulation of the nestlings is established the female seldom leaves the nest (Plate III. *below*). She broods the chicks almost constantly raising herself sometimes to get annoying insects from the nest bottom or to take out carefully larvae of *Protocalliphora* from the ear openings of small nestlings. During the hot hours of the day the hen stands with extended wings above the nestlings protecting them from the direct sun rays (Plate III *above*). Before leaving the nest the adult bird slowly raises herself a little, ruffles her feathers on the belly, carefully tucks up and puts her wings together making herself clear of the chicks or eggs. On rapid and sudden upward flight the female sometimes throws about the contents of the nest. On returning she puts back in their place only immovable objects, i.e. eggs or newly hatched nestlings. In my field journal there is the following record: 'July 7, 1961. With an imprudent gesture I frightened away a female which brooded four chicks and one egg

with punctured (cracked) shell. When flying the hen scattered two young and the egg some 30-40 cm. distance from the nest-cup and the egg broke. Soon the female returned and started brooding the nestlings left in the nest. Without paying attention to the other chicks she examined intently the newly-born nestling and debris of the egg-shell. Then she suddenly raised herself, took the shell by the beak and put it accurately in the nest between the chicks. In some seconds she raised again, took out from under herself the egg-shell which apparently was mistaken by her for the egg and began to eat the blood stained shell membranes. Then leaving the shell the bird again started looking at the white ball lying down motionlessly near by, came to it, and carried back in her beak the newly-hatched chick to the nest. The older nestlings got to the nest as soon as they heard the feeding call of the female.'

While the nestlings are very small the female spends nearly all her time in the nest and is fed by her mate as well as during egg-incubation. The cock usually flies several times above the nest calling his mate. The hen answers with a plaintive, thin, whistling note and rises into the air. When flying alongside the male the female sharply brakes and with quick side movement of the foot catches the food and returns to the nest. During the hatching period or in rainy weather sometimes the male with prey clutched in his talons flies lower and lower and drops it in the nest. Systematic observation upon two families of Pied Harriers has shown that within first 10-12 days of the nestling's life the male never visits the nest. 19-20-days-old young are brooded by the female only at night or in rainy weather and during a sudden fall in the temperature. Thereafter the chicks remain alone in the nest for longer and longer periods, the female and her mate being engaged in hunting. When the hen is absent the male feeds young by tearing the food to bits.

MOULT

Adult Pied Harriers have one complete moult in a year. Soon after incubation begins the old worn out feathers of the females start to fall and are replaced by new ones; the moult of the males, who provide food for the family, occurs when the young are airborne. In Amurland on June 6-9 there were birds that had lost the 10th and 9th primaries. By 15th-16th of June these feathers were half grown and the next ones (8th and 7th) fell out. At the same time the corresponding coverts and small plumage of the breast, sides and back moulted. The female shot in Transbaikalia on June 13 (preserved in

Neufeldt : Pied Harrier



Above : Pied Harrier (female) protecting nestlings from the direct rays of the sun ; *Below* : Pied Harrier female brooding partly grown young.

(Photos : I. Neufeldt)

Neufeldt : Pied Harrier



Above and Below : Pied Harrier female feeding young.

(Photos : I. Neufeldt)

collection of the Zoological Institute of the Academy of Sciences) is approximately in the same state of moult; 10th and 9th primaries in sheaths, 8th absent. On June 21-26 in the majority of individuals from Amurland the 10th primary flight feathers had reached normal length, and the 9th and 8th were $\frac{4}{5}$ of normal length. On June 28 in one female the 10th primaries had moulted, the 9th were $\frac{4}{5}$ and 8th and 7th $\frac{2}{3}$ of normal length. In southern Ussuriland the moult takes place at the same time. Thus in the female shot on 15th June the 10th and 9th primaries were $\frac{2}{3}$, and the 8th $\frac{1}{2}$ of normal length, and the central rectrices had begun to unfold; in another female shot on June 27 the new 10th, 9th, and 8th primaries had reached normal length, the 7th were still in sheaths (Materials of Zool. Inst. Acad. Sci., U.S.S.R.). In the specimens from Upper Amurland in the first days of July, i.e. by the time of chicks hatching, the female's 10-8th primaries and their coverts had finished their growth. Some individuals exceptionally begin moulting only in July. All adult females shot on September 8-16 in Manchuria were (according to Meise 1934) in the moulting state. H. Deignan (1945) on 27th December found in birds wintering in northern Thailand central rectrices, which had not reached the normal length.

Male Pied Harriers start moulting later than the females and not so simultaneously. In the collection of the Zoological Institute in Leningrad there are the following moulting specimens: June 18—the 10th primaries $\frac{1}{2}$ of normal length, 9th appearing from the sheaths, one central rectrix half grown; on June 19—10th primaries in horny sheaths, 9th remiges and one middle tail feather absent; on June 28—10th primaries of normal length, 9th $\frac{3}{4}$ of normal length. On the 27-28 June in the region of the Upper Amur the majority of the males had lost the 8th and even the 7th primaries though specimens occurred without any signs of moult. To the number of late-moulting birds may be referred a male taken on July 25 from the nest with grown-up chicks: his 10th primaries hardly reached $\frac{4}{5}$ and one central rectrix $\frac{1}{2}$ of normal length. It should be noted that in females the change of tail feathers usually started when some remiges had already moulted; males lost the central rectrices nearly at the same time with the last (10th), sometimes the last but one (9th) primaries. Before leaving the breeding range males, as a rule, have time to change not less than 6 primaries, half the rectrices, and the majority of the small feathers on the head, neck, lower throat, back and belly (a specimen from Ussuriland housed in Zool. Inst. Acad. Sc., U.S.S.R.). Beginning with the nest building the moult continues during migration and is completed in the winter-quarters. The shortage of material at my

disposal does not enable me to describe the whole process of the Pied Harrier's moult.

AUTUMN MIGRATION

There are rather scanty data in the literature concerning the time of autumn migration of Pied Harriers. Thus, they were observed to migrate gradually from Ussuriland from the end of September till the middle of October; only solitary birds stayed as long as November 13 (Dulkeit 1928; Shulpin 1936; Vorobiev 1954; Belopolsky 1955). In autumn the birds sometimes stray beyond the limits of the range. Thus according to A. Gizenko (1955), one female was shot on October 24, 1946 on Sakhalin (near the town of Novo-Aleksandrovsk). In the middle of September Pied Harriers occur rather often in Manchuria and Korea (Ingram 1909; Kuroda 1931; Yamashina 1932; Meise 1934; Austin 1948). In China, in Hopei province, groups or solitary birds migrate southwards from the end of August till the end of October, sometimes till November 9 (La Touche 1932; Shaw 1936; Wilder & Hubbard 1938). The migration routes cross China and sometimes Mongolia. G. Dementiev (1962) recorded the Pied Harrier on passage in autumn of 1958-1960 in Mongolian Gobi Desert. In Burma the earliest appeared on September 6, the latest in November (Bingham 1880; Smythies 1953). In western Kwangsi (China) they were recorded from October 30 (Eaton 1957) and in northern Thailand from October 4 (Deignan 1945).

FOOD, HUNTING, AND FEEDING OF YOUNG

The analysis of the contents of stomachs and pellets as well as direct observations upon hunting and feeding Pied Harriers have shown that the major part of their diet in the south of the Amur-Zeya plateau was constituted by rodents (85%)¹. The most common were Ungur Voles (*Microtus unguurensis*) inhabiting hummocky boggy swales and willow and dwarf birch thickets. Siberian and Redbacked Voles (*Clethrionomys rutilus*) confined to well drained parts of forests, fields, and gardens make only 23% of their diet. Other species of rodents (*Apodemus agrarius*, *Micromys minutus*, *Clethrionomys rufocanus*, and *Eutamias sibiricus*) were equally represented in the food ration of these diurnal predators (5-3%). Eighteen per cent of the prey of Pied Harriers was formed of the remains of small passerine birds. In May, adult Yellow-breasted Buntings (*Emberiza aureola*) sometimes became the prey of these harriers; at the end of

¹ The bone remains of the mammals were kindly identified by M. Erbaeva.